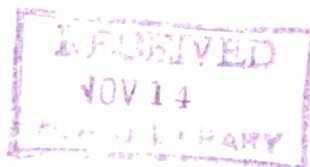


DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES
== JOHN W. FINCH, DIRECTOR ==

INFORMATION CIRCULAR

ACCIDENT EXPERIENCE AND DIRECT COSTS IN SOME
COLORADO COAL MINES, 1929-33



BY

E. H. DENNY AND F. R. JENNINGS

**AFTER THIS REPORT HAS SERVED YOUR PURPOSE AND IF YOU HAVE NO FURTHER NEED FOR IT, PLEASE RETURN IT TO
THE BUREAU OF MINES, USING THE OFFICIAL MAILING LABEL ON THE INSIDE OF THE BACK COVER.**

INFORMATION CIRCULAR

DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

ACCIDENT EXPERIENCE AND DIRECT COSTS IN SOME COLORADO
COAL MINES, 1929-33^{1/}

By E. H. Denny^{2/} and F. R. Jennings^{3/}

This paper discusses accident experience and costs in 150 Colorado coal mines for the 5 years 1929-33; these mines produced 62 percent of Colorado's coal tonnage during this period. This and similar studies by the United States Bureau of Mines in other States (listed in the appendix to this report) make available comparable information on mine-accident costs and bring out clearly the importance of accident reduction from the humanitarian as well as from the economic standpoint.

Compensation insurance costs constitute a considerable part of the cost of coal output. The tendency toward greater liberalization of workmen's compensation laws and increased benefits thereunder may mitigate to some extent the seriousness of an accident to a worker and his dependents, but no compensation payment can restore life or limb or eliminate human suffering. Compensation is paid ultimately, not by an insurance fund but by the mine operator and the general public, which includes the miner. The one really effective method of reducing compensation costs is to reduce the number and severity of accidents.

Acknowledgment

The authors gratefully acknowledge their indebtedness to the following for assistance in compiling this report and in interpreting the data presented: The Colorado Industrial Commission; the State Compensation Fund officials and employees, particularly Mr. Wortman, manager, and Mr. Shaw, actuary; and the Employers Mutual Insurance Co. officials and employees, particularly Mr. Smith, underwriting manager, and Mr. Campbell, office manager.

-
- ^{1/} The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U.S. Bureau of Mines Information Circular 6860."
^{2/} District engineer, U.S. Bureau of Mines Safety Station, Denver, Colo.
^{3/} Assistant clerk, U.S. Bureau of Mines Safety Station, Denver, Colo.

Summary of Compensation and Medical Costs in
Colorado Coal Mines for 1929-33

1. The actual compensation cost of 2,755 compensable Colorado coal-mine accidents during the 5 years 1929-33 was \$922,768.80. Estimated medical costs for these 2,755 cases, based on known medical costs for 430 cases, and estimated medical costs for 2,001 noncompensable accidents, based on known medical costs for 635 cases, aggregate \$201,098.82. The direct compensation and medical cost of the 4,756 accidents (2,755 compensable and 2,001 noncompensable) was therefore about \$1,124,000. These accidents occurred in mines producing about 62 percent of Colorado's coal; therefore the probable 5-year direct cost of accidents to all Colorado coal mines in compensation and medical payments was about \$1,800,000. This figure does not include cost of insurance administration.

2. Each compensable case averaged \$350 in compensation and \$67 in medical charges.

3. The major compensation costs are for fatalities, permanent total disabilities, and permanent partial disabilities. The 8 permanent total disabilities average more than \$16,000 each, fatalities more than \$2,500 each, and permanent partial disabilities nearly \$1,000 each.

4. Compensable injuries involving no permanent disability cost about \$51 each in compensation and \$46 in medical charges.

5. Noncompensable injuries cost about \$3.50 each in medical charges.

6. Coal-mine accidents in Colorado cost in compensation and medical payments approximately \$0.05 per ton of coal produced.

7. The causes of coal-mine accidents in Colorado were about the same as in the United States as a whole. In many instances accident reports indicate that the accidents could have been prevented. Experience in numerous mines in the United States has shown that the number and severity of accidents can be greatly decreased; in some mines accidents have been eliminated for long periods.

8. Payments to injured men during time off for accidents, exclusive of the 10-day waiting period for temporary compensable disabilities, ranged from an average of \$1.63 per day in 1929 to \$1.16 per day in 1933.

Important accident data for 150 Colorado coal mines,
1929-33

Number of mines	150
Coal production, 5 years tons	21,991,672
Man-days worked, 5 years	4,618,679
Fatal accidents	110
Permanent total disabilities	8
Temporary disabilities (compensable)	2,224
Permanent partial disabilities	413
Total compensable accidents	2,755
Total noncompensable accidents	2,001
Days lost by all accidents (compensable and noncompensable) ..	1,186,456
Days lost per accident (compensable and noncompensable)	249.47
Accidents per fatality	43.20
Coal produced per fatality tons	199,924
Coal produced per accident (compensable and noncompensable) do	4,624
Direct compensation costs cents per ton	4.2
Direct compensation and medical cost do	5.1
Number lost-time accidents	3,993
Frequency rate of accidents (lost-time accidents per million man-hours worked)	108.1
Severity rate (days lost per 1,000 hours worked)	32.1

NOTE. - Figures on coal production, days the mines worked, and number of men employed in each of the 150 mines, are from annual reports of the Colorado State Coal-Mine Inspector for 1929-33. Eight hours are taken as a working day.

Methods Employed in Accident Study

Through the cooperation of the Colorado Industrial Commission and the Employers Mutual Insurance Co. engineers of the United States Bureau of Mines were given access to the individual reports of coal-mine accidents occurring in mines insured by the State Fund and the Employers Mutual Insurance Co. These reports covered approximately 150 coal mines which produced approximately 22,000,000 tons of coal of a total of 35,677,618 tons for the State as a whole during the period 1929-33. Six mines operated by coal companies carrying their own insurance and small uninsured mines were not included in this study.

The Workmen's Compensation Act of Colorado (sec. 30) provides that:

Every employer shall keep a record of all injuries, fatal or otherwise, received by his employees in the course of their employment. Within 10 days after the occurrence of an accident resulting in personal injury, a report thereof shall be made, in writing by the employer to the commission, upon forms prescribed for that purpose. Such reports shall contain such information as shall be required by the commission.

The employer's report and those made by the mine operator to the commission are in most instances fairly complete, giving information as to the place, time, and cause of the accident, length of disability, part of body injured, and employee's rate of earnings.

This paper is based on information obtained from individual files covering 4,756 compensable and noncompensable coal-mine accidents in Colorado for 1929-33, inclusive. The authors believe that it furnishes a practically complete and accurate record of the number of accidents, direct causes of accidents, nature of injuries, and compensation payments to date for all coal mines covered by compensation other than the mines of the 6 companies operated by self-insurers. Compensation payments for this 5-year period will be increased slightly by the occasional reopening of supposedly closed cases; a claim case cannot be considered absolutely closed until after the death of the claimant through natural or other causes. In a few unsettled cases of severe injuries future compensation payments have been estimated. In cases of permanent total disability a life-expectancy table (p. 54, Workmen's Compensation Act of Colorado, Expectancy Table C. L. sec. 6,537) was used in computing the future compensation payments to be made. Complete medical and hospital costs were available for tabulation and study only for claims paid by the State Fund; reports on claims of the Employers Mutual Insurance Co. covered only compensation and burial costs, the individual mine operator member taking care of medical costs. In some instances the insurance company (and the State Fund as well) assumes additional expense for extra medical, surgical, and hospital service in efforts, often successful, in lessening the degree of permanent disability of an injured person and thus enabling his return to useful employment with resultant decrease of compensation.

The number of days lost from accidents that do not involve permanent or total disability or death is the number of days elapsing from the day of the disability to the time of return to work, including Sundays and holidays. Where the injured man did not report back for work the attending doctor's estimate of time lost has been used. The compensation awards for permanent partial and total disabilities and fatalities vary in the several States, and to make figures on days lost comparable, the table (table 9) for weighting industrial accident disabilities recommended by the Association of Industrial Accident Boards and Commissions was used. Thus, a fatality or permanent total disability is rated as 6,000 days lost time, loss of a finger as 300 days, and other permanently disabling injuries proportionately. In most cases this weighting system gives a loss of time considerably greater than that figured from the award made, but in other cases involving a long period of temporary disability in addition to a permanent-partial-disability award the number of days lost by the weighting system is less.

The figures include coal-mine accidents occurring in and about the mines during 1929-33 inclusive, but do not include coal-trucking accidents. The period of disability for the compensable accidents listed was more than 10 days. In a few cases no compensation was paid because of inability to locate the injured man or failure of the injured man to make claim within the legal

6-month period, and in some fatal-accident cases only funeral costs were included because the victims had no dependents. The noncompensable cases include all the injured reported as disabled for 10 days or less; many of the no-lost-time accidents involve considerable medical cost.

Cost of Accidents

From 1929 to 1933, inclusive, there were in and about Colorado coal mines, excluding self-insurers, 2,755 lost-time accidents involving more than 10 days each and 2,001 lost-time accidents involving 10 days or less each, a total of 4,756 lost-time accidents. A total of \$922,768.80 was paid in compensation (including \$28,173.75 for funeral, extra surgical, hospital, dental, and miscellaneous fees) for these 2,755 compensable accidents. The medical cost of 430 compensable cases for which figures were available was \$28,733.16 (66.82 each), and the reported medical cost of 635 noncompensable cases was \$5,396.75 (\$8.50 each). If these figures represent average medical costs of compensable and noncompensable cases the estimated total medical cost for all compensable accidents is \$184,092.68 and for all noncompensable accidents, \$17,006.14.

The estimated total compensation and medical fees for these 4,756 cases is therefore \$1,123,867.62, of which \$922,768.80 represents compensation payments.

A large part of the total compensation cost of Colorado coal-mine accidents is due to fatalities, permanent total disabilities, and permanent partial disabilities; 110 fatalities cost in compensation \$277,346.46 or an average of more than \$2,520 per fatality. It is estimated that 8 permanent total disabilities will cost \$128,563.88 in compensation or that these men now totally blind or with broken backs or similar injuries barring them from work for life will receive, on the basis of \$14 or less compensation per week, an average of more than \$16,000 each.

The compensation for 413 permanent partial disabilities, many involving such serious impairment as loss of an eye, cost \$403,616.84 or an average of more than \$977 each. The total compensation cost of the 531 fatalities, permanent total, and partial disabilities is \$809,527.18, leaving a compensation cost of \$113,241.62 for the 2,224 remaining compensable injuries involving no permanent disability. The average compensable case involving no permanent disability therefore cost only \$50.92 in compensation. Based on a compilation of 352 cases, such a case costs \$45.78 in medical bills.

Time Lost in Accidents

The time lost by the injured in mine accidents is of interest. In the 4,756 accidents reported 1,186,456 days, an average of 249.5 days per accident, were lost; 2,755 of these accidents were compensable, and the average days lost for each compensable case was 428.2. It should be remembered that in calculating days lost a permanently disabling accident or a fatality is rated by the scale of time losses given in table 9; thus, the loss of a leg below

the knee is equivalent to 3,000 days and a fatality to 6,000 days. Of these accidents 2,001 were noncompensable, and the average time lost, including 763 no-lost-time accidents, was 3.4 days. Based on an average of 290 cases, the no-lost-time accidents averaged in medical care \$7.30, and 12 of them involving no lost time but injury to teeth cost \$12 to \$71 each for dental care. These data are given in detail in tables 2 and 3.

Causes and Prevention of Accidents

Table 4 gives the immediate causes of accidents and average days lost from each cause according to the United States Bureau of Mines classification. However, comment on the proximate causes, based on individual accident reports, is worth while. The term "proximate" is used for the many factors that contribute to an accident; for example, condition of surroundings or equipment, system of mining, illumination, pitch of coal seam, mine practices, discipline, supervision, state of mind of the injured at time of accident, fatigue, ill health, lack of mental alertness, poor eyesight, carelessness, recklessness, loose clothing - any or several of these may be more important in causing accidents than the immediate cause ascribed.

Means of preventing mine accidents are discussed in many Bureau of Mines publications; a list of publications dealing with the prevention of any particular class of accidents may be obtained by writing to the Bureau, which has assembled general data regarding coal-mine accident prevention in illustrated lecture form and for several years has given instruction on this subject throughout the United States. The lectures require approximately 20 periods of 2 hours each.

Adequate safety supervision, discipline, and safety education of mine officials and miners are essential for the general reduction of mine accidents. Cooperation of miner and official is necessary for successful accident prevention, but management must take the lead in safety work. Proper safeguarding of mine surroundings and equipment, good upkeep, and periodic safety inspection of equipment, safety instruction, safety bulletins, and general safety meetings are means by which a company can take that leadership in safety work so necessary in obtaining the cooperation of the workers.

During the last 3 years there has been a marked reduction in the number of coal-mine accidents in the United States on a frequency as well as on a tonnage basis. Numerous mines in various sections of the United States are establishing safety records much above the average and often extending over a considerable period. More than 70 percent of the bituminous coal produced in the United States in 1932 came from mines that reported no fatal accidents. During 1934 one western coal mine produced more than 205,000 tons of coal and employed 144 men without a lost-time injury. Another western coal mine operated from April 1923 to January 1, 1935, without a fatality, producing more than 3,000,000 tons of coal and employing more than 200 men during this period. During the 1933 National Safety Competition conducted by the United States Bureau of Mines 6 bituminous coal mines working 100,000

to 200,000 man-hours operated the entire year without a lost-time accident. In at least one of these mines natural roof conditions were decidedly unfavorable.

Causes 1, 2, and 3. - Falls of rock, coal, and draw slate (see table 4) caused almost 30 percent of all accidents listed in this paper. The average number of days lost per injury from roof falls (416) was about 60 percent more than from the average injury. Falls of roof or coal (table 7) caused 59 (about 54 percent) of the 110 fatalities in these mines. In Colorado and in the United States as a whole about half of all bituminous coal-mine fatalities and 30 percent of all nonfatal injuries are caused by falls of rock, coal, or draw slate or falls of face or rib. Briefly, essentials in reducing accidents from roof falls, particularly at the working face, are frequent and careful testing of roof by miners and officials to determine its safety, the immediate barring down or supporting of unsafe roof, and an adequate system of timbering suited to the particular mine. An adequate timbering system should provide not only for normal timbering requirements in a working place but also for additional timbering under roof conditions that are below the average; timbers must be set where and when needed. As long as the miner determines the need and position of a prop the toll of lives of both experienced and inexperienced miners will continue; on the other hand, systematic timbering, supervision, and discipline unquestionably can prevent roof-fall accidents and in many instances have greatly reduced the accident total. Roof testing by the vibration method where practicable should disclose any weakness in large slabs found not drummy by ordinary striking. Even where timbering is done systematically in some mines an occasional so-called kettle bottom or pot of rock will fall; if such abnormal roof defects are frequent the use of lagging at least should give warning so that the men could escape. Mining methods and speed of extraction are also vitally important in their relation to roof-fall accidents; poor mining methods are responsible for many mine accidents.

As a preventive of fatal and serious injuries from falls of smaller amounts of rock or coal the protective hat is excellent, but it should not be expected to take the place of adequate timbering. In many Colorado mines protective headgear is required underground and about the tippie. Many lives have been saved and serious injuries prevented by wearing protective hats in and around mines.

Cause 6. - Falls of persons underground caused about 3.7 percent of all accidents. Many of these accidents were due to stumbling. Elimination of stumbling hazards requires that travelways be kept as clear as possible and adequate illumination be provided where the hazard cannot be avoided readily.

Cause 7. - Handling materials caused about 11 percent of all accidents. Such accidents are less severe than the average. Protection of hands and feet is of considerable importance in preventing them; suitable gloves would reduce hand injuries, and protective shoes would decrease foot injuries.

Causes 8 and 23. - Hand tools caused 16 percent of all injuries; most of these injuries were relatively slight. The use of proper tools is important in avoiding injuries; sharp picks and axes and good handles tend to decrease accidents from tools. Numerous eye injuries are included in accidents from hand tools. Sometimes the report was not specific as to the cause of the eye injury, the accident being reported as due to flying coal or rock; possibly some of these injuries were received while shoveling coal or rock, but most of them were received during picking and hammering.

Of the 4,756 accidents reported (tables 4 and 5), 531 involved eye injuries; many of these were trivial and caused no lost time, but in 65 cases the result was total or partial loss of one eye. The average compensation cost was more than \$700 and the average number of days lost, more than 1,100 each. Protective goggles are supplied the miners in many Colorado mines, and their use is required in certain mining operations, particularly picking. Nevertheless, it is manifest that their actual use is by no means universal, as indicated by the 120 eye injuries received in 1933.

Cause 9. - Stepping on nails or other sharp objects caused relatively few injuries with little cost and time lost. Good mine housekeeping involving general orderliness and removal of protruding nails from boards, ties, etc., is important in eliminating such injuries, as are good soles on shoes.

Cause 11. - In Colorado, as in other States, mine haulage ranks next to roof falls as a cause of mine accidents. Haulage accidents also have practically the same high severity rate as accidents from roof falls. During the period 1929-33 20.38 percent of all mine accidents in Colorado occurred in underground haulage and about 1 percent in surface haulage. In more than half of these accidents the men were struck, run over, or squeezed between cars or between car and rib, timber, or roof. Relatively few men are employed in haulage compared with other mine operations, and the ratio of fatal and nonfatal accidents to the number of men employed, is high in Colorado and in the United States as a whole. Supervision of haulage work is always difficult. Adoption of definite rules regarding haulage practices, insistence on compliance therewith, and careful selection of haulage employees would reduce such accidents. Some of the other factors entering into haulage-accident prevention are proper equipment, proper maintenance of equipment and haulageways, suitable lay-out of haulage for safe as well as efficient haulage of coal, and maintenance of adequate man clearance along haulageways. The human equation undoubtedly is important in the occurrence as well as in the prevention of haulage accidents in coal mining, but the responsibility of the management as regards haulage equipment, installations, and methods is much greater in connection with haulage accidents than is usually believed.

Cause 12. - Before 1928 numerous gas and dust explosions occurred in Colorado bituminous-coal mines with great loss of life and damage to property. During recent years, however, there have been few explosions from this cause in Colorado mines. Factors contributing to this improvement are probably better mine ventilation, better company inspection of mines and testing for gas, vigilance on the part of the State mine-inspection department, and

probably several others; unquestionably another contributory element is the matter of good fortune or luck. During 1929-33, 11 men were burned in Colorado coal mines by gas, indicating that the old danger of ignition of explosive gas still exists and that gas is still being ignited occasionally with consequent danger of a general dust explosion and disaster. Rock-dusting as a means of preventing the spread of coaldust explosions in coal mines generally is known but is adequately practiced in only a few Colorado coal mines.

Cause 13. - Explosives caused relatively few accidents (24 or 0.05 percent of all accidents), but such injuries were usually serious, the severity rate being about twice that of the usual type of mine accident. In many Colorado mines accidents from explosives probably have been prevented by the practice of blasting by shot firers after the shift is out of the mine. The present tendency in Colorado is toward increased use of explosives during the working shift, particularly where mechanical loading has been introduced; the shots are fired by miners as well as by shot firers. This tendency is likely to increase the number of explosives accidents as well as mine explosions; only by careful supervision of explosives practice can serious accidents be avoided when blasting is done during the working shift.

Cause 14. - Electricity caused relatively few accidents, but the severity rate and compensation cost were high owing to 7 electrocutions from contact with trolley and power lines and electrical equipment during the 5-year period. Adequate guarding of trolley and power lines and proper grounding of fixed and portable electrical equipment are factors in eliminating such accidents. As long as men are exposed to long stretches of unguarded trolley and power lines 6 feet or less above the rail, electrocutions will be numerous. Experience of electric-power companies has amply demonstrated the danger to workers of even 110-volt current; voltages of 220 to 500 in the mines are correspondingly dangerous.

The electric contact hazard in mines is intensified because the electric wiring and equipment must be installed in a relatively confined space, usually near places where workmen must pass or labor, the underground illumination is generally poor compared with that on the surface, and the men may contact rails, pipes, and water at the same time they contact a power conductor. Elimination of this hazard appears to be mainly a problem of management.

Cause 17. - Two fatalities caused by escape of gases from a sealed mine fire illustrate the danger of inadequately sealed and inspected fire areas.

Accidents Classified According to Parts of Body Injured

Table 5 classifies accidents according to parts of the body injured; the accidents listed under head, eye, hand and finger, and foot involve injury only to one part of the body. Accidents that result in injuries to several parts of the body are included under miscellaneous injuries with all other accidents not falling into the first four classifications. Table 5 further classifies accidents according to number involving total or partial loss of eye and number of hernia injuries. The number of head injuries (157) is relatively small, possibly due in part to extensive use of protective hats,

although accidents with head injuries do not appear to be decreasing in number. In many instances of severe injury to the head, as from the falling of a large slab of rock, other parts of the body are injured also; these accidents appear under "miscellaneous." Eye injuries have been discussed briefly under accidents from hand tools; 531 eye injuries occurred during the 5-year period - 120 in 1933, more than in any of the 4 preceding years. During this year, however, there was a material reduction in the number of cases of total or partial loss of eyesight with 7 such cases against 19 in 1929. Experience of some mining companies indicates that virtually all eye injuries could be eliminated by the use of goggles. Objections to the use of goggles are: The wire-screen type reduces illumination approximately 20 percent; the glass goggle, particularly in warm and poorly ventilated places, tends to fog and wiping the glass continually smears it with dirt; a wire-screen goggle or an uncorrected glass goggle may hinder a man with poor eyesight and increase his liability to other accidents, as from roof falls or haulage. Nevertheless, many companies have found that these apparent difficulties can be overcome and that by rigid supervision the men can be induced to wear goggles during underground work. The safety engineer of a large western company employing more than 1,000 men underground stated that eye injuries formerly costing up to several thousand dollars a year had been eliminated by examination of the eyes and compulsory use of goggles with lenses fitted to correct defects in vision; approximately 1½ years after their introduction there were no eye injuries in the mines of this company. The men are required to use goggles during all underground mining operations. Another western company which began to use goggles 6 or 7 years ago also has virtually eliminated eye injuries.

More than 1,000 hand and finger injuries were reported. Most of these were slight, but there were numerous instances of loss of one or more fingers or parts thereof.

Foot injuries (765) also show a comparatively low severity rate, although in the 5-year period they have not tended to decrease in number. More general use of protective footwear should, however, decrease such accidents both in frequency and in severity.

During the period studied hernia cases increased from 12 in 1929 to 23 in 1933 in spite of the fact that the law in Colorado provides that (1) the appearance of hernia must have been accompanied by pain and (2) that it was immediately preceded by some accidental strain suffered in the course of employment. The law also provides that an employee may elect to be operated upon; in the event that he does not so elect he loses the right to compensation for further aggravation of the injury.

Appendix

The tables (1 to 9) in this appendix give detailed information on the cost, frequency, severity, and causes of accidents in the majority of Colorado coal mines for 1929-33, inclusive. Information also is included regarding the part of the body injured and the average daily payments to injured men. The main facts disclosed by these tables have been discussed in the body of this paper.

Table 1 gives by years the compensable accidents in approximately 150 Colorado mines. The number is approximate because some mines closed and others began operations during the 5-year period studied. The days lost from injury are actual days lost for nonpermanent disabling accidents but are weighted losses for fatalities and permanent disabilities, as shown in table 9. The compensation costs cover actual payments made to injured persons or their dependents and extra medical care not provided by law but do not include the cost of insurance administration. The medical costs are for the cases for which medical cost was reported, about one sixth of all compensable cases; from this partial medical-cost survey an estimate has been made of total medical cost for all cases.

Table 2 gives by years the noncompensable accidents in the same mines. Medical costs were reported for about one third of the cases, and from these the total medical cost of all noncompensable accidents was estimated. As shown in the table, several of these cases involved no loss of time but did involve considerable medical cost.

Table 3 is a composite summary for the 5-year period of compensable and noncompensable accidents classified separately according to cause. The average number of days lost and average compensation paid for each cause shown in this table indicate the relative accident severity rate for each cause.

Table 4 is a composite summary for the 5-year period of all accidents by causes and shows days lost, percentage of accidents from each cause, and average number of days lost from each cause. The relative frequency and severity of accidents from each cause are included.

Table 5 classifies accidents in Colorado coal mines by years according to parts of the body injured and lists separately cases of loss of vision and hernia. It also gives the cost and time losses for these various classes of injuries.

Table 6 gives the cost by year and average cost of each case of fatal and permanently disabling accidents and table 7 the causes of the 110 fatal accidents that occurred during the 5-year period.

Table 8 gives the average daily compensation paid per case for compensable temporary disabilities; this has decreased yearly owing to the annually reduced working time.

Table 9 shows the scale of time losses used in this paper for weighting permanent partial and total disabilities and fatalities.

I.C. 6860

TABLE 1. - Compensable accidents in 150 Colorado coal mines, 1929-33

Year	Compensable accidents	Days lost	Compensation cost, all accidents	Medical cases reported	Medical cost of reported cases	Estimated total medical cost	Estimated total compensation and medical cost
1929	621	361,294	\$281,743.20	79	\$5,653.95		
1930	507	269,429	215,878.16	60	4,618.09		
1931	558	172,071	152,385.11	88	6,324.85		
1932	538	215,429	150,447.93	94	5,735.77		
1933	531	161,357	122,314.35	109	6,400.50		
Total	2,755	1,179,580	\$922,768.80	430	\$28,733.16	\$184,092.68	\$1,106,861.48
Average	1 551	1 235,916	334.94		2 66.82		2 401.76

1 Per year.

2 Per case.

3 Actual medical costs were available for 430 of the 2,755 cases reported; from these costs the estimated total medical cost was calculated.

TABLE 2. - Noncompensable accidents in 150 Colorado coal mines, 1929-33

Year	All noncompensable accidents	Days lost	Medical cases reported	Medical cost of reported cases	Estimated total medical cost	No. lost-time accidents	Medical cases reported	Medical cost of reported cases	Estimated total medical cost
1929	340	1,469	68	\$630.60		93	28	\$187.60	
1930	343	1,157	77	612.45		139	32	199.00	
1931	416	1,346	189	1,520.60		165	83	569.10	
1932	444	1,357	155	1,257.50		135	83	591.70	
1933	458	1,547	146	1,375.60		181	64	568.50	
Total	2,001	6,876	635	\$5,396.75	\$17,006.14	763	290	\$2,115.90	\$4 \$5,567.01
Average	1 400	1 1,375		2 8.50		1 153		2 7.30	

1 Per year.

2 Per case.

3 Actual medical costs were available for 635 of the 2,001 cases reported; from these costs the estimated total medical cost was calculated.

4 Actual medical costs were available for 290 of the 763 cases reported; from these costs the estimated total medical cost was calculated.

I.C. 6860

TABLE 3. - Accident causes, costs, and days lost in 150 Colorado coal mines, 1929-33

Cause	Compensable accidents				Noncompensable accidents		
	No. of cases	Days lost	Average days lost	Compensation cost	Average compensation cost	No. of cases	Average days lost
Underground							
1. Falls of roof (rock, coal, or draw slate)	867	531,767	613.34	\$427,956.85	\$493.61	414	1,580
2. Falls of roof due to car or machine knocking out post	1	6,000	6,000.00	4,419.45	4,419.45		
3. Falls of face or rib	87	26,309	302.40	17,948.45	206.30	42	111
4. Rush of coal rock or gob	8	632	79.00	711.72	88.96	3	14
5. Other falling material or objects (not being handled by injured)	40	6,247	156.18	5,098.28	127.46	36	162
6. Falls of persons	35	29,583	348.04	22,318.46	262.57	90	330
7. Handling material -							
A. Coal or rock	219	29,523	134.81	31,287.59	142.87	159	547
B. All other material	53	6,791	128.13	7,425.95	140.11	36	329
8. Hand tools	267	58,420	218.80	42,699.79	159.92	421	1,434
9. Stepping on nails or other sharp objects	3	48	16.00	25.72	8.57	13	34
10. Striking or bumping against objects	19	570	30.00	450.39	23.70	23	70
11. Mine cars and mine locomotives -							
A. Struck, run over or squeezed between	258	162,541	630.00	157,894.45	611.99	96	386
B. Squeezed between car and rib, timber and roof	184	69,843	379.58	50,125.24	272.42	87	343
C. Derailments	34	14,953	439.79	8,935.70	262.81	8	39
D. Rerailing cars	53	5,171	97.57	7,072.98	133.45	11	22
E. Pushing or pulling cars by hand (strain from)	26	1,758	67.62	4,633.69	178.22	19	82

I.C. 6860

TABLE 3. - Accident causes, costs, and days lost in 150 Colorado coal mines, 1929-33 - Continued

Cause	Compensable accidents				Noncompensable accidents			
	No. of cases	Days lost	Average days lost	Compensation cost	Average compensation cost	No. of cases	Days lost	Average days lost
Underground - con.								
F. Animals on haulage	66	19,152	290.18	\$14,428.85	\$218.62	50	215	4.30
G. Falling from cars (not run over)	9	6,347	705.22	2,029.01	232.11	6	20	3.33
H. Other haulage accidents	38	4,253	111.92	3,041.03	80.03	24	80	3.33
12. Explosions of gas or coal dust	10	6,363	636.30	4,889.81	488.98	1	9	9.00
13. Explosives not including explosions from gas or dust	17	12,469	733.47	5,362.28	315.43	7	51	7.29
14. Electricity (not resulting in explosions)	18	52,210	2,900.56	18,231.89	1,015.66	13	43	3.31
15. Machinery (not including 12 and 14)	133	19,011	142.94	19,424.58	146.05	60	202	3.37
A. Mining machines	13	3,350	257.69	1,646.61	126.66	9	15	1.67
B. Drills	22	8,267	375.77	2,980.33	135.47	9	34	3.78
C. All other suffocation from mine natural gases (not from fires or explosions)								
						1	10	10.00
17. Mine fires (burns, suffocations, etc.)	2	12,000	6,000.00	4,278.13	2,139.06	3	0	0
18. All other accidents underground	17	601	35.35	538.20	31.66	50	96	1.92
Total underground	2,549	1,094,179	429.26	\$865,965.43	\$339.73	1,751	6,258	3.57

I.C. 6860

TABLE 3. - Accident causes, costs, and days lost in 150 Colorado coal mines, 1929-33 - Concluded

Cause	Compensable accidents				Noncompensable accidents		
	No. of cases	Days lost	Average days lost	Compensation cost	Average compensation cost	No. of cases	Average days lost
Shaft							
19. Vertical or inclined shaft	15	8,564	570.93	\$5,867.26	\$391.15	6	1.17
Surface							
20. Mine cars or locomotives	20	2,253	112.65	1,274.29	63.71	13	3.06
21. Railroad cars and locomotives	8	12,956	1,619.50	4,444.36	555.54	7	4.86
22. Handling materials	21	2,123	101.10	905.07	43.10	52	1.83
23. Hand tools	26	3,916	150.62	1,938.36	74.55	34	2.44
24. Falls of persons	45	18,261	405.80	15,512.35	344.72	35	3.14
25. Falling objects	13	1,983	152.54	1,564.56	120.35	20	1.95
26. Machinery	31	24,021	774.87	15,160.88	489.06	25	1.80
27. Electricity	1	13	13.00	6.00	6.00	7	3.00
28. Explosives	1	27	27.00	12.13	12.13	9	3.67
29. All other surface accidents	24	11,156	464.83	9,987.78	416.16	37	2.59
Total surface	190	76,709	403.73	\$50,805.80	\$267.40	244	2.50
Cause unknown	1	128	128.00	\$130.31	\$130.31		
Grand total	2,755	1,179,580	428.16	\$922,768.80	\$334.94	2,001	3.44

3376

- 15 -

TABLE 4. - Colorado compensable and noncompensable coal-mine accidents by cause, percentage, and days lost, 1929-33

Cause	No. of cases	Percent of total	Days lost	Average days lost
<u>Underground</u>				
1. Falls of roof (rock, coal, or draw slate)	1,281	26.94	533,347	416.35
2. Falls of roof due to car or machine knocking out post	1	.02	6,000	6,000.00
3. Falls of face or rib	129	2.71	26,420	204.81
4. Rush of coal, rock, or gob	11	.23	646	58.73
5. Other falling material or objects (not being handled by injured)	76	1.60	6,409	84.33
6. Falls of persons	175	3.68	29,913	170.93
7. Handling materials				
A. Coal or rock	378	7.95	30,070	79.55
B. All other material	149	3.13	7,120	47.79
8. Hand tools	683	14.47	59,854	87.00
9. Stepping on nails or other sharp objects	16	.34	82	5.12
10. Striking or bumping against objects	42	.88	640	15.24
11. Mine cars and mine locomotives				
A. Struck, run over, or squeezed between	354	7.44	162,927	460.25
B. Squeezed between car and rib, timber, or roof	271	5.70	70,186	258.99
C. Derailments	42	.88	14,992	356.95
D. Rerailing cars	64	1.55	5,193	81.14
E. Pushing or pulling cars by hand (strain from)	45	.95	1,840	40.89
F. Animals on haulage	116	2.44	19,367	166.96
G. Falling from cars (not run over)	15	.32	6,367	424.47
H. Other haulage accidents	62	1.30	4,333	69.89
12. Explosions of gas or coal dust	11	.23	6,372	579.27
13. Explosives (not including explosions of gas or dust)	24	.50	12,520	521.67
14. Electricity (not resulting in explosions)	31	.65	52,253	1,685.58
15. Machinery (not including 12 and 14)				
A. Mining machines	193	4.06	19,213	99.55
B. Drills	22	.46	3,365	152.95
C. All other	31	.65	8,301	267.77
16. Suffocation from mine gases (not from fires or explosions)	1	.02	10	10.00
17. Mine fires (burns, suffocations, etc.)	5	.11	12,000	2,400.00
18. All other accidents underground	67	1.41	697	10.40
Total underground	4,300	90.42	1,100,437	255.92

TABLE 4. - Colorado compensable and noncompensable coal-mine accidents by cause, percentage, and days lost, 1929-33 - Continued.

Cause	No. of cases	Percent of total	Days lost	Average days lost
<u>Shaft</u>				
9. Vertical or inclined shaft	21	.44	8,571	408.14
<u>Surface</u>				
10. Mine cars or mine locomotives	38	.80	2,308	60.74
11. Railway cars and locomotives	15	.32	12,990	866.00
12. Handling materials	73	1.53	2,218	30.38
13. Hand tools	60	1.26	3,999	66.65
14. Falls of persons	80	1.68	18,371	229.64
15. Falling objects	33	.69	2,022	61.27
16. Machinery	56	1.18	24,066	429.75
17. Electricity	8	.17	34	4.25
18. Explosives	10	.21	60	6.00
19. All other surface accidents	61	1.28	11,252	184.46
Total surface	434	9.12	77,320	178.16
Cause unknown	1	.02	128	128.00
Grand total	4,756	100.00	1,186,456	249.47

I.C. 6860

TABLE 5. - Compensable and noncompensable accidents in 150 Colorado coal mines, 1929-33
classified according to parts of the body injured

	Head injuries	Eye injuries	Total or partial loss of eye	Hand and finger injuries	Foot injuries	Hernia	Miscellaneous injuries
1929							
Number of cases	18	97	19	197	155	12	494
Days lost	453	20,417	19,620	16,641	11,902	1,128	313,350
Compensation	\$662.13	\$14,324.62	\$13,829.57	\$10,316.91	\$12,064.57	\$3,051.87	\$244,374.97
Days lost per case	25.17	210.48	1,032.63	84.47	76.79	94.00	634.31
1930							
Number of cases	28	93	17	182	139	14	408
Days lost	18,350	17,183	16,578	11,478	17,484	1,186	206,091
Compensation	\$5,672.40	\$11,154.87	\$10,900.16	\$6,898.34	\$13,449.30	\$1,676.29	\$178,703.25
Days lost per case	655.36	184.76	975.18	63.07	125.78	84.71	505.12
1931							
Number of cases	45	111	10	203	164	16	451
Days lost	8,496	11,570	13,380	17,224	13,610	677	122,517
Compensation	\$3,457.56	\$7,704.78	\$8,467.63	\$10,765.23	\$11,744.86	\$1,053.00	\$118,712.68
Days lost per case	188.80	104.23	1,338.00	84.85	82.99	42.31	271.66
1932							
Number of cases	32	110	12	209	151	20	480
Days lost	12,371	13,977	13,320	15,489	4,662	1,294	170,237
Compensation	\$5,171.00	\$10,733.13	\$10,463.96	\$8,182.54	\$3,895.19	\$1,471.29	\$122,466.12
Days lost per case	386.59	127.06	1,110.00	74.11	30.87	64.70	354.76
1933							
Number of cases	34	120	7	212	156	23	467
Days lost	18,526	9,140	10,170	14,302	8,210	3,929	112,726
Compensation	\$10,040.51	\$4,751.68	\$5,191.90	\$7,659.86	\$6,704.19	\$5,050.36	\$93,158.11
Days lost per case	544.88	76.17	1,452.86	67.46	52.63	170.83	241.38
Total							
Number of cases	157	531	65	1,003	765	85	2,300
Days lost	58,196	72,287	73,068	75,134	55,868	8,214	924,971
Compensation	\$25,003.60	\$48,669.08	\$48,853.22	\$43,822.83	\$47,858.11	\$12,302.81	\$757,415.13
Days lost per case	370.68	136.13	1,124.12	74.91	73.03	96.64	402.16

I.C. 6860

TABLE 6. - Cost of fatal and permanent partial and total disability accidents
in 150 Colorado coal mines, 1929-33

Year	Fatal- ities	Compensation cost (includ- es funeral)	Cost per case	Permanent total dis- abilities	Compensation cost	Cost per case	Permanent partial dis- abilities	Compensation cost	Cost per case	Total compensation
1929	37	\$98,276.23	\$2,656.11	3	\$63,365.12	\$21,121.71	98	\$92,453.37	\$943.40	\$254,094.72
1930	27	68,619.53	2,541.46	2	37,040.08	\$18,520.04	82	89,226.32	1,083.13	194,885.93
1931	12	31,416.18	2,618.02	2	22,906.68	11,453.34	83	72,496.64	873.45	126,819.50
1932	21	47,124.39	2,244.02	1	5,252.00	5,252.00	75	78,164.73	1,042.20	130,541.12
1933	13	31,910.13	2,454.63				75	71,275.78	950.34	103,185.91
Total	110	\$277,346.46	\$2,521.33	8	\$128,563.88	\$16,070.48	413	\$403,616.84	\$977.28	\$809,527.18

TABLE 7. - Fatalities in Colorado coal mines by cause, 1929-33

Cause	1929	1930	1931	1932	1933	Total
1. Falls of roof (rock, coal, or draw slate)	20	15	5	11	5	56
2. Falls of roof due to car or machine knocking out post	1					1
3. Falls of face or rib	1		1			2
6. Falls of persons	2	1				3
11. Mine cars and locomotives						
A. Struck, run over, or squeezed between	4	2	2	8		16
B. Squeezed between car and rib, timber or roof	1	4	1			6
C. Derailments	1				1	2
E. Animals on haulage		1		1		2
G. Falling from cars (not run over)				1		1
12. Explosions of gas or coal dust			1			1
13. Explosives (not including explosions of gas or dust)	1					1
14. Electricity (not resulting in explosions)	4	1			2	7
15. Machinery (not including 12 and 14)						0
A. Mining machines		1				1
C. All other					1	1
17. Mine fires (burns, suffocations etc.)					2	2
19. Vertical or inclined shaft			1			1
21. Railway cars and locomotives	1	1				2
24. Falls of persons		1			1	2
25. Falling objects	1					1
26. Machinery			1			1
29. All other surface accidents					1	1
Total	37	27	12	21	13	110

TABLE 8. - Average compensation for compensable temporary disability in Colorado coal mines, 1929-33

Year	Number of cases	Days lost	Days lost adjusted for 10-day waiting period	Compensation paid	Compensation per day
1929	483	21,779	16,949	\$27,643.48	1.63
1930	396	17,089	13,129	20,992.23	1.60
1931	461	21,636	17,076	25,565.61	1.50
1932	441	20,160	15,750	19,903.86	1.26
1933	443	20,610	16,180	19,128.44	1.18
Total	2,224			\$113,241.62	
Average per case				50.92	

1 Average compensation per day of temporary disability, excluding the 10-day waiting period for which no compensation is paid.

TABLE 9. - Scale of time losses for weighting industrial accident disabilities to show severity of accidents, according to the Association of Industrial Accident Boards and Commissions

Nature of injury	Degree of disability in percent of permanent total disability	Days lost
Death	100	6,000
Permanent total disability	100	6,000
Arm above elbow, dismemberment	75	4,500
Arm at or below elbow, dismemberment	60	3,600
Hand, dismemberment	50	3,000
Thumb, any permanent disability of	10	600
1 finger, any permanent disability of	5	300
2 fingers, any permanent disability of	12½	750
3 fingers, any permanent disability of	20	1,200
4 fingers, any permanent disability of	30	1,800
Thumb and 1 finger, any permanent disability of	20	1,200
Thumb and 2 fingers, any permanent disability of	25	1,500
Thumb and 3 fingers, any permanent disability of	33-1/3	2,000
Thumb and 4 fingers, any permanent disability of	40	2,400
Leg above knee, dismemberment	75	4,500
Leg at or below knee, dismemberment	50	3,000
Foot dismemberment	40	2,400
Great toe or any 2 or more toes, any permanent disability of	5	300
1 toe, other than great toe, any permanent disability of	0	---
1 eye, loss of sight	30	1,800
Both eyes, loss of sight	100	6,000
1 ear, loss of hearing	10	600
Both ears, loss of hearing	50	3,000

United States Bureau of Mines Publications on Accident Costs

1. CRAWFORD, F. S., The Cost of Accidents to Industry.
Inf. Circ. 6333, 1930, 10 pp.
2. ASH, S. H., Accident Experience and Cost of Accidents in Washington Coal Mines. Inf. Circ. 6529, 1931, 18 pp.
3. MURRAY, A. L., and HARRINGTON, D., Accident Experience of the Coal Mines of Utah for the Period 1918 to 1929. Inf. Circ. 6530, 1931, 26 pp.
4. FEENE, W. J., Accident Experience and Cost in Pennsylvania Anthracite and Bituminous mines, 1926-30. Inf. Circ. 6618, 1932, 29 pp.
5. CASH, F. E., Accident Experience and Cost in Tennessee Coal Mines. Inf. Circ. 6664, 1932, 8 pp.
6. HERBERT, C. A., Ten years of Fatal Accidents and Two Years of Accident Costs in Indiana Coal Mining. Inf. Circ. 6672, 1932, 12 pp.
7. ASH, S. H., Accident Experience and Cost of Accidents at Washington Metal Mines and Quarries. Tech. Paper 514, 1932, 35 pp.
8. PARKER, D. J., Accident Experience and Costs in Wyoming Coal Mines. Inf. Circ. 6791, 1934, 13 pp.
9. DENNY, E. H., and ANUNDSEN, E. A., Accident Experience and Costs in Colorado Metal Mines. Inf. Circ. 6713, 1933, 23 pp.
10. DAVIES, J. F., and HUMPHREY, H. B., Accident Experience and Cost in Virginia Coal Mines. Inf. Circ. 6763, 1933, 15 pp.